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University of Applied Sciences

Bachelor of Culture and Arts/Design

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DESIGN AND PRODUCTION OF JEWELRY LINE

Bachelor's Thesis 2014

ABSTRACT

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Jewelry adornments play very important role in modern society. Modern design in many branches of it and in jewelry design as well, in order to conform to the requirements of saturated market, should consider on all stages of design and production processes, number of different factors, in order to conform to the needs of particular target group.

The objective of the project was to design and produce ready to wear line of silver rings and earrings for a new brand "Shibumi", which orientates on internet as a main market. Study of design and production methods, which were used, and process of developing them along the project in order to meet at the same time requirements of the market and end customer; main values and design statements of the company.

The analysis of the contemporary jewelry market was the first step in the project. Study of brands values and design statement were balanced with the chosen modeling and production methods, user profile information, designer's inspirational sources. With the goal of providing client with the jewel that user does not get tired of it but all the time will find some new meanings and aesthetic values in it.

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LIST OF TERMS

<i>adornment</i>	A thing which adorns or decorates; an ornament.
<i>aesthetic</i>	A set of principles underlying the work of a particular artist or artistic movement.
<i>alloy</i>	A metal made by combining two or more metallic elements, especially to give greater strength or resistance to corrosion:
<i>burnout</i>	The reduction of a fuel or substance to nothing through use or combustion.
<i>classicism</i>	The following of ancient Greek or Roman principles and style in art and literature, generally associated with harmony, restraint, and adherence to recognized standards of form and craftsmanship, especially from the Renaissance to the 18th century. Often contrasted with romanticism.
<i>conformity</i>	Compliance with standards, rules, or laws.
<i>crucible</i>	A ceramic or metal container in which metals or other substances may be melted or subjected to very high temperatures.
<i>distributing</i>	Supply (goods) to retailers.
<i>emphasis</i>	Special importance, value, or prominence given to something.
<i>ensuring</i>	Make certain that (something) will occur or be the case.
<i>flashy</i>	Ostentatiously attractive or impressive.

<i>flux</i>	A substance mixed with a solid to lower its melting point, used especially in soldering and brazing metals or to promote verification in glass or ceramics.
<i>gold-plated</i>	Covered with a thin layer of gold:
<i>hallmark</i>	A mark stamped on articles of gold, silver, or platinum by the State assay offices, certifying their standard of purity.
<i>implication</i>	The conclusion that can be drawn from something although it is not explicitly stated.
<i>indispensable</i>	Absolutely necessary.
<i>intangible</i>	Unable to be touched; not having physical presence. Difficult or impossible to define or understand; vague and abstract.
<i>integrity</i>	The state of being whole and undivided.
<i>laser</i>	A device that generates an intense beam of coherent monochromatic light (or other electromagnetic radiation) by stimulated emission of photons from excited atoms or molecules. Lasers are used in drilling and cutting, alignment and guidance, and in surgery; the optical properties are exploited in holography, reading barcodes, and in recording and playing compact discs.
<i>mold</i>	A hollow container used to give shape to molten or hot liquid material (such as wax or metal) when it cools and hardens.
<i>ornament</i>	Decoration added to embellish something
<i>oxidation</i>	The process or result of oxidizing or being oxidized
<i>pattern</i>	A repeated decorative design

<i>reliability</i>	A person or thing with trustworthy qualities
<i>scalpel</i>	A knife with a small, sharp, sometimes detachable blade, as used by a surgeon
<i>shrinkage</i>	The process, fact, or amount of shrinking
<i>solder</i>	A low-melting alloy, especially one based on lead and tin or (for higher temperatures) on brass or silver, used for joining less fusible metals.
<i>spatula</i>	An implement with a broad, flat, blunt blade, used for mixing and spreading things, especially in cooking and painting.
<i>stamp</i>	Impress a pattern or mark, especially an official one, on (a surface, object, or document) using an engraved or inked block or die or other instrument:
<i>statement</i>	A definite or clear expression of something in speech or writing

1 INTRODUCTION

Nowadays, jewelry has a great meaning for many cultures, than it ever had in the past. It has become an indispensable fact that people use different types of jewelry to beautify themselves. Jewelry also plays an important role in case of events such as weddings, anniversaries and birthdays. This thesis project concentrates on a process of designing a line of jewelry pieces for a new company “Shibumi”, and on a process of producing final product such as ready to wear silver rings and earrings, as well it studies the chosen method of production and a ways of blending that method into the design process.

In modern world, the Internet became a very highly developed environment for communication with customers. At the same time it is in fact very convenient and cheap enough marketing and trading platform. Those are the main reasons why a company orientates on internet as a main market. That market sets some specifications to the final appearance of the product, which is wise to take into account.

Modern design in many branches of it and in jewelry design as well, in order to conform to the requirements of saturated market, should consider all stages of design and production processes, such factors as geographical location of design and production premises, geographical location of the “end user”, the ways of retailing the product, and a number of other qualifying aspects of the particular target group. Closer involvement of design process to communication with the end user and to marketing research projects, as a result gives a product, which fulfills needs of a particular consumer in studied region. This strategy supports the idea of consumer oriented design, which is becoming a new trend nowadays.

The study of those factors is given below in this work. Another part of the project covers the study of design and production methods, which were used, and process of developing them along the project in order to meet at the same time requirements of the market and end customer; main values and design statements of the company. My own motivation is substantiated from interest in jewelry, and possibility of applying the knowledge of different materials and methods, gained

during the study of disciplines in general not that usual for the jewelry designer. That allows me to have unusual approach in solving design and production problems during the project.

2 ANALYSIS OF CONTEMPORARY JEWELRY MARKET

2.1 History and development of jewelry craft

Historians and archaeologists are saying that it is still difficult to answer the question: “What has a person manifested before - need for clothing or a desire to decorate themselves?” - British expedition, who worked in the valley of the river Ak Akchei in Asia Minor, found the grave of the lady related to the Paleolithic era, with bracelets and beads. That became the most ancient sample of well dressed woman found during the history, who was wearing the jewelry set also. (Jewelry for all times 2011)

History of jewelry is a long and interesting story about development, directly linked with the evolution of mankind. People started to decorate themselves long before even the simplest method of processing material was invented. First adornments in ancient prides were for sure colors, drawings and change of a skin color, accomplished with colored earths. With daubs and smears of these same materials, the face could be turned into a patterned mask that symbolically permitted a metamorphosis of persona. Transformations could be made permanent on face and body by tattooing, still in wide use by many peoples. (Untracht.O. and Hale.R.1985:1)

Ancient people were using things which were made by nature itself, for example naturally polished stones, teeth and bones of animals. Even now, it is possible to catch the breath of those ancient times in some modern tribes as Figure 1 illustrates.

In the development of human culture, the idea evolved that the magic act of transformation itself imbued a condition of magic to the changed and perfected object. This belief was projected upon all early jewelry, whose prime purpose was for use as an amulet, a charm to protect the wearer against the real or imagined calamities and threats to life. (Untracht.O. and Hale.R. 1985:2-3)



Figure 1. Example of adornment in modern tribe

The big step for the development of ancient jewelry art, was enabled with the discovery of gold. At the same time first goldsmiths established the foundation of the jewelry art.

In the Middle Ages the general rise in different areas like trade, crafts, science and art began. It caused fast development in jewelry craft. Professional historian looking at the piece of jewelry from different century can understand what was influencing common culture at that time in general.



Figure 2. Ancient Stamp-ring.

The “Golden age” for the jewelry art was the period from the middle of XVIII to the end of XIX centuries, which was the time when classicism was dominating. At this time all goldsmiths were making innovations exclusively for women, men were left with ring and tie clip. Brilliant is on the top of jewelry world at that time, it shines in rings, earrings, bracelets, necklaces, pendants. Whole sets of jewelry made in the same style become more important than ever. Ring is one of the oldest jewelry pieces. Like any closed circle ring symbolizes integrity, so it was used as an emblem of marriage since ancient times. First rings looked like just twisted thick wire of metal, but they were worn not only on fingers, but attached to hands, sewn to the dress, scarf or hat. Ring was an identification mark, to show wellness of the owner, his power and belonging to a tribe, it was also used to mark goods of the owner and other property.

In the XV-XVII centuries rings were often used as a stamp. An example of an ancient stamp ring is presented in Figure 2. It was cut and engraved on emeralds, agates, and other stones, and set to a metal ring decorated with enamel. The main motives of these rings were people, eagles, lions, or cut monograms of the owners.



Figure 3. Ancient African golden ring

2.1.1 Development of casting technology

For producing jewelry pieces in this project, “Lost wax casting” technique was used. Casting process developed 6000 years ago, and it begun art and science of metallurgy, or the extraction of metals from ores, which started with cooper.

About a thousand years later the metallurgy of gold, silver, lead and antimony were also established. Casting techniques proceeded from the simple one-piece open mold to the two-part closed mold. Because metal becomes fluid and plastic when heated to high enough temperature, entirely new forms in unlimited variety could be made. Figure 3 shows an example of ancient african golden ring produces with the casting method.

It is good to remember that for many centuries before the recent and widespread adoption by craftsperson of the practice of vacuum or investment casting, the most common method for jewelry casting was static casting of gravity pouring, by which the metal fills the mold cavity simply through the force of gravity. This ancient system is still widely used today. (Untracht.O. and Hale.R. 1985:482-483)

The gravity pouring technique can be carried out using different materials for the molds. They can be made of any substance that can be easily impressed, shaped by

pressure, carved, or poured and then allowed to solidify. The important requirement is that these substances must be able to retain their form without disintegrating when they are subjected to the high heat of the molten metal used. The materials used to make a mold: sand, clay, soft stone, cuttlebone, soil, feces, wood.



Figure 4 . Ancient casted earrings.

2.2 Conjuncture of the modern jewelry market

Jewelry industry is highly fragmented with thousands of artists and companies competing to get its place on the market. Finnish jewelry market has few main players who has national distribution system, and about 300(in 2013) individual metal smiths. The majority of them are running their own workshops producing jewelry as handcraft.

Jewelry market now is distinguished not only by interest of growing retail chains, as well as decreasing the amount of middle traders, but also in the use of new methods of retail. The most successful and quickly growing market for jewelry is Internet. This method of trade belongs to so called “niche trade”, which is oriented to groups of buyers with specific needs or unique combination of needs. Internet is

very useful tool for the company to present itself, brand values, vision; to have better customer knowledge. Collecting the databases containing detailed information about customers and their preferences, is very important task in niche trade. Creating client database is especially significant in today's environment. Saturation of market, increases competition, and the consumer has a wide choice of offers, which constantly increasing the importance of other factors, like quality, reliability, story behind the brand and product.

Big jewelry producers are mostly interested in retail stores, and this will play dominant role in the trade market of any European country. Companies who were only distributing products are starting to disappear, due to several reasons: one is that manufacturers try to reach the consumer directly, using direct marketing. Secondly, it is becoming increasingly common for producers to open their own offices in different countries, to sell then straight to retailers. Another reason is the very common franchise system, when retailers follow a marketing strategy, trading style and corporate style of manufacturer. A retailer confirms by transferring deposit, or buying rights to use manufacturer's trademark to sell goods of producer.

Under such conditions for a new company, which is just starting to sell, and does not have budget to open retail boutique, Internet is the most suitable platform. It's important to understand that potential consumer, does not have opportunity to hold the piece in hands, which sets some requirements to the choice of materials, techniques and forms of the product.

2.2.1 Who buys jewelry and why?

Zi Ye and Tao Jiang (2013) in their research project, made for bachelor thesis, "Importing Neoglory Jewelry to Finland". Zi Ye and Tao Jiang (2013) had 58 female and 30 male responders. Out of them 81 responders that were under 35 years old, the rest 7 responders were 35 or more than 35 years old. Their ages mainly distribute in 17 - 19 years old and 20 - 24 years old. The research shows that 56% of all responders usually purchase jewelry for themselves and 44% by it as a gift for someone else. Among all the responders, about 80% males purchase jewelry for someone else, while 90% females by is for themselves. Among the all

responders, 63% purchase jewelry 2 — 3 times a year, about a quarter of responders purchase jewelry every 2 — 3 months and 10% responders purchase jewelry once a month .This 10% is female.

When purchasing jewelry, several factors are always considered by customers, such as the quality, material and price of the jewelry. According to the above-mentioned study by Zi and Tao (2013), the most important factor for responders is a design of a piece, which can be seen in Figure 5 – it has estimated grade 4.52, on a scale from 1 to 5, price and quality are less but still important, with the grades 4.12 and 4.02, material choice seems not that important for half of responders – grade 3.82. More than 30% responders take into account the brand, service, package and repeat purchasing experience of jewelry. The most worn jewelry according to survey are earrings; necklace and ring are also widely worn by responders, as could be seen on Figure 6. Figure 7 shows the most popular jewelry material among responders. More than 60% responders vote for silver and white gold. Thus, silver and white gold are very popular material here. (Ye and Tao 2013)

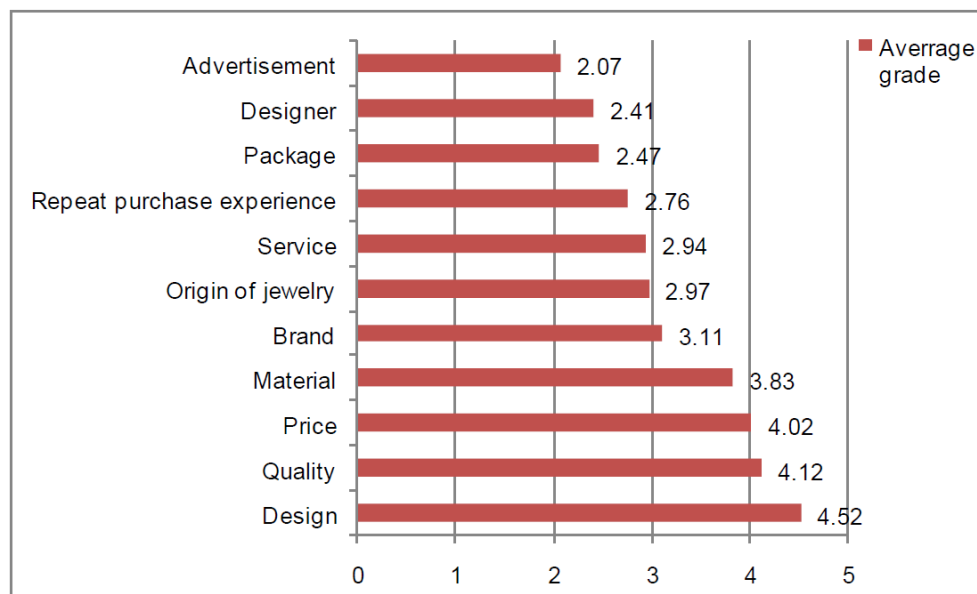


Figure 5. Average grade of factors importance while purchasing jewelry. (Source Zi and Teo 2013: Appendix)

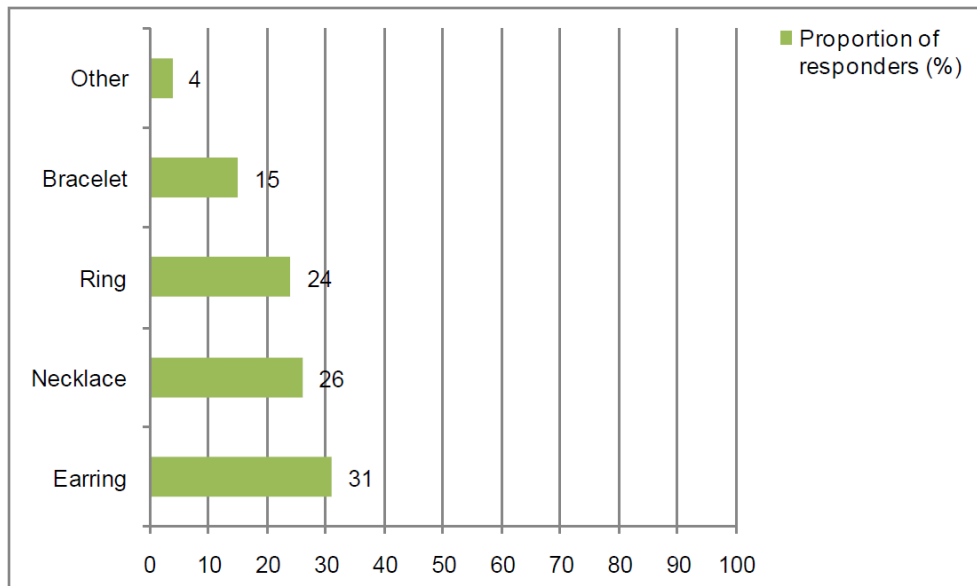


Figure 6. Most often worn jewelry.

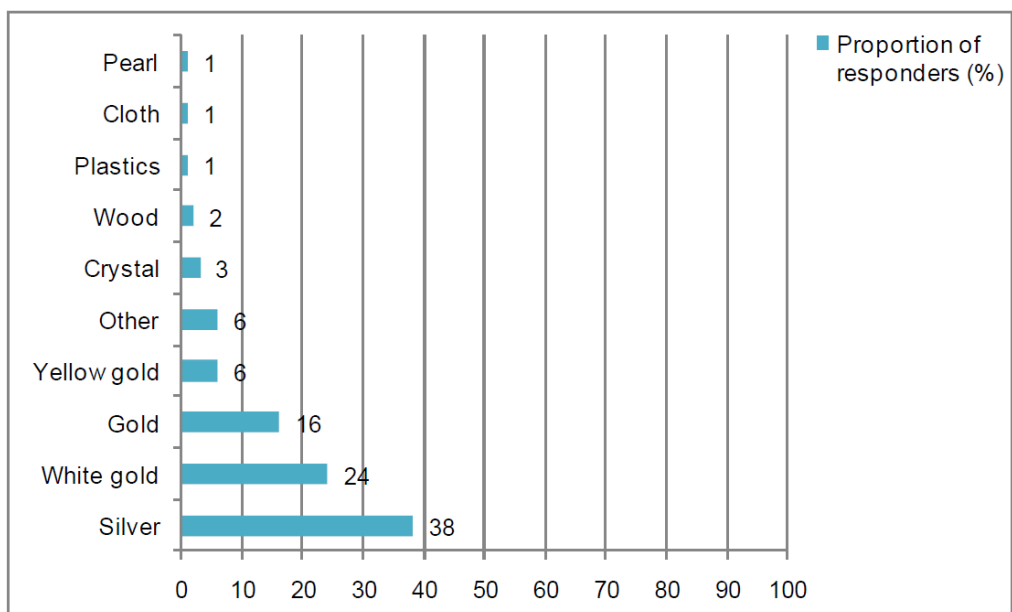


Figure 7. Popular material

2.3 Mass production versus unique jewelry

Mass production is the producing of identical items in extremely large volume on a continuous basis. Cheaper cost, of producing the final product, compared to hand crafted pieces, of course, makes it more popular. Mass production has taken over the world, since Henry Ford has created his first mass produced Ford Model T, at the beginning of 20th century. (Vella Lisa. 2014.)

Workers producing jewelry on an assembly line are not putting any extra time or effort into the products, they do only what their job is, and what they are getting paid for. In that conditions quality can not be perfect for each piece.

Crafters take pride in the quality of their products. When looking at a hand crafted piece, you can clearly see that craftsman's talent, time and energy are present in his creation. Great effort is brought into each individual piece - making sure that each of them is of a highest quality, and has unrepeatable touch. Also hand crafted jewelry is original. It is also possible to pick a one of a kind piece of jewelry that embodies your individual taste. If there is something you like, but cannot find, many crafters take individual offers to make exactly what you ask for. When buying mass produced, people get what everyone else has, but one reason many people wear jewelry is to stand out. People want to wear jewelry which represents them as unique personality, by being unique itself. Of course, mass production has its advantages too. Large retailers make prices for jewelry more affordable for middle class society.

2.4 Consumer-oriented features and requirements for the jewelry

So called "Consumer-oriented" features, are those manifesting itself while direct use of the product by the customer. This applies to personal adornment (rings, bracelets, brooches). They must fit to certain requirements, mostly aesthetic, that

customer could have while using it, including social, functional, ergonomic, hygienic and aesthetic properties, safety and reliability of consumption.

2.4.1 Social characteristic of a product

Social characteristic of a product – show is its compliance to needs of the target group that contributes to the expediency of its production, distribution and consumption.

2.4.2 Functional properties

Functional properties determine conformity to the purpose of an object of consumption. This applies both to form and to the construction of the product, which must conform to its purpose (cup holder must hold a glass, ring should adorn and be comfortable on a finger).

2.4.3 Ergonomic properties

Ergonomic properties of the goods cause the convenience and comfort of its use by the consumer. This applies to the pieces of personal jewelry (earrings, brooches, rings), and other groups of jewelry design and shape of which should provide the user experience. Requirements for ergonomic properties are depending though on the assignment of the piece. For example marriage ring (Example Figure 8) that would be worn daily should not cause any uncomfortable experience, but some statement jewelry (Example Figure 9), which is to be worn only on special occasions, could have the shape and adornments, that would be impossible to use daily.



Figure 8. Example of engagement ring, with great ergonomic properties



Figure 9. Example of Statement ring, not for everyday use.

2.4.4 Hygienic properties

Hygienic properties determine the conditions for the body and human performance when interacting with the product. So, earrings hooks shall be made of precious metals or be gilded, not to be oxidized in the ear piercing and do not cause disease.

2.4.5 Reliability of consumer goods

Reliability of consumer goods - is consumer's property, causing the preservation of the basic parameters of the product and its functioning in time and within matching the criteria of consumption. This particularly applies to the construction of locks, chains links, settings of stones, in personal ornaments (brooches, earrings,

bracelets, etc.). No jewelry should have sharp edges or protrusions, or other details that could hurt human skin.

2.4.6 Aesthetic characteristic of a product

Aesthetic characteristic of a product characterizes its ability to express in sensible signs in form and structure their social value and cultural significance. Other aesthetic characteristics of jewelry include its balanced beauty, originality, reasonableness of size and miniaturization, interesting and comfortable texture properties of materials, quality of surface finish. Jewelry can be considered beautiful only if their harmonious form corresponds to a particular function, and material.

2.5 Basic materials for jewelry production

In Finland, the raw materials for articles of precious metals are gold, silver, platinum, and palladium. Products made of base metals and coated with precious metals, e.g. gold-plated necklaces and bracelets or electrolytic ally coated items, are not regarded as articles of precious metals.

The choice of materials used to make the jewelry, is critical determinant of customer value (beauty, reliability, durability, safety, hygiene, ease of use). Pure precious metals are usually too soft for manufacturing purposes; they are therefore used in alloys with other metals. Alloyed materials are also used to achieve the desired color, better treatment characteristics and lower raw-material costs. For example white gold is an alloy of gold and at least one white metal, usually nickel, manganese or palladium. Like yellow gold, the purity of white gold is given in karats.

2.5.1 Alloys of gold and silver.

White gold's properties are changing according on the metals and proportions used. As a result, white gold alloys can be used for many different purposes; while a nickel alloy is very hard and durable and therefore good for rings and pins. Gold-

palladium alloys are soft, bendable and used for white gold pieces with gemstone settings, sometimes mixed with other metals like copper, silver, and platinum for weight and durability.

Rose gold is a gold and copper alloy which is mostly used for specialized pieces. Rose gold, also known as pink gold and red gold, was popular in Russia at the beginning of the 19th century, and was also called “Russian gold”. Wedding rings, pendants, earrings made out of rose gold are becoming more popular in the 21st century.

Example of Silver Alloy which is widely used for jewelry production is Argentum Sterling silver is a modern sterling silver alloy which modifies the traditional alloy (92.5% silver + 7.5% copper) by replacing some of the copper with the metalloid germanium. As it contains at least 92.5% silver content of the traditional alloy, it is still referred to as sterling silver. Argentum Silver is the result of research by Peter Johns at the Art and Design Research Institute (ADRI), School of Art & Design, Middlesex University. The project began in 1990 with research on the effects of germanium additions to silver alloys. Germanium was discovered to impart the following properties to sterling silver:

- fire scale elimination
- high tarnish resistance
- precipitation hardening and simple heat-hardening properties
- increased ductility
- increased thermal and electrical resistance (making alloys suitable for welding and laser forming)
- environmental advantages (associated with not having to remove or plate over fire scale)

2.5.2 Recycling of the gold and silver

For centuries, man history has a very close relationship with precious metals. Not only by its beauty, but also value these metals became so important for human. That explains the amount of jewelry that can be found in people’s bank vaults as a

savings for bad times. According to U.S Geological Survey, there is roughly 171,300 tons of gold that have been mined in history. This is rising at a high rate of 3000 tons every year.

Mining of gold is a very harmful process for our environment. About 20 tons of toxic waste is generated to produce a single gold ring. Toxic materials used in the process of mining are also polluting air and water.

Therefore, we cannot possibly continue enjoying these precious metals when they wreak havoc on our planet. . Options include using mining methods that are more eco-friendly. This might mean stopping dumping the toxic wastes into oceans and rivers or stop using things like mercury and cyanide. However, the best solution is recycling of the gold that we have already.(Recycling Gold, Silver & Other Precious Metals)

Secondary sources of gold and silver nowadays are about equal to domestic prime production from mining. Industrial scrap is collected in the form of clippings, stampings, filings, polishing, plated material, contaminated solutions, chemical ware, plated wire, and electronic waste materials. Old jewelry yields about twenty percent collected.

Recycling of precious metals has many benefits. This includes cheaper products, less degradation of environment and production of less toxic wastes to the environment. (Untracht.O. and Hale.R. 1985:33)

2.6 Legal requirements for articles

There are a number of legal requirements for articles of precious metals which are sold in Finland. The requirements apply to precious metal alloy finesses, technical solutions, and marks. Anybody bringing articles of precious metals onto the market in Finland is liable to ensure that the product:

- has a fineness of precious metal alloy that is approved in Finland , listed in figure 10
- carries marks that indicate at least the fineness and the responsible organization
- contains solders permitted for the precious metal, and that a low-fineness solder is used only to the extent necessary for the soldering
- fillings are used in permitted articles only, and the product description provides the product structure
- only have base metal parts that are clearly distinguishable from the precious metal parts
- fulfils all the legal requirements in addition to precious metal legislation.

Permitted precious metal finenesses and solders			
Precious metal	Chemical symbol	Fineness*	Lowest allowed fineness of solder*
Gold	Au	999	750
Gold	Au	916	750
Gold	Au	750	750
Gold	Au	585	585
Gold	Au	375	375
Silver	Ag	999	550
Silver	Ag	925	550
Silver	Ag	830	550
Silver	Ag	800	550
Platinum	Pt	999	Solder's fineness of precious metal 800
Platinum	Pt	950	
Platinum	Pt	900	
Platinum	Pt	850	
Palladium	Pd	999	Solder's fineness of precious metal 700
Palladium	Pd	950	
Palladium	Pd	850	
Palladium	Pd	500	
*) in thousandths of mass			

Figure 10. Permitted precious metal finesses and solders

2.7 Technical requirements

2.7.1 Finenesses and solders

The product's gold, silver, platinum or palladium fineness should at least be that indicated in the fineness mark; lower finenesses are not allowed – see the Figure 11. The fineness marks must not bear any other digits. In certain cases, solders may have a fineness lower than that of the material itself. (Articles of precious metals in Finland 2005:5-6)

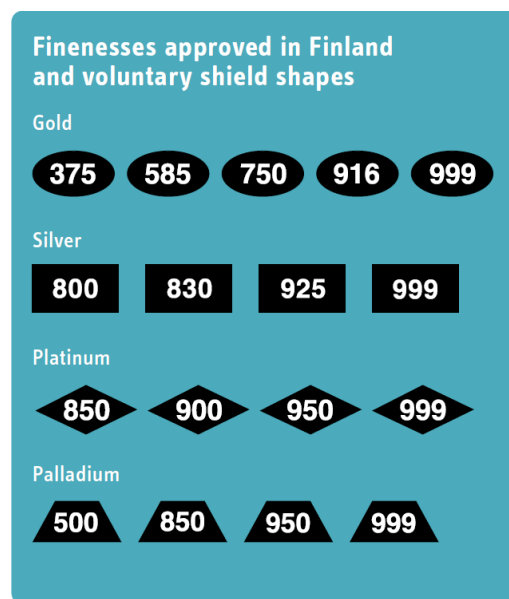


Figure 11. Finenesses approved in Finland

2.7.2 Fillings

No precious metal with fineness lower than that indicated by the fineness mark, base metal, other material or solder can be used to reinforce, fill or increase the weight of the article. Acceptable low-fineness solders should be used only to the extent necessary for soldering.

2.7.3 Kinds of coating

Articles of precious metals may have coatings. The fineness mark on a coated article indicates the fineness of the precious metal that has been coated. For example, a gold-plated piece of silver jewelry weighing over 10 grams should be marked with a fineness mark for silver, in addition to the responsibility mark or the hallmark. Nevertheless, no parts made of base metals or other materials and coated with a precious metal can be used in an article of precious metals.

2.8 Marking

A mark is a permanent marking intended for articles of precious metals. Hallmarks are either punched or marked by laser onto the article; other marks may be punched, cast, engraved or marked by laser. After the marking, the article may not be processed in such a way that the specific features of the marks are made less distinct. For example, cast jewelry is manufactured in several treatment stages, where the clarity of a cast mark must not be affected. (Articles of precious metals in Finland 2012:8)

2.8.1 Mandatory marks and weight limits

Articles of precious metals released onto the market and intended for sale in Finland must carry a responsibility mark registered with “Tukes” and a fineness mark, or alternatively a hallmark of a national assay office plus a fineness mark. The manufacturer, importer and retailer of an article of precious metals are responsible for ensuring that a product on sale bears at least the mandatory marks.

Articles of precious metals containing a minimum of 1 gram of gold, platinum or palladium are subject to the mandatory markings. For silver products, the limit is 10 grams. The marking of articles whose precious metal content is below the weight limits is voluntary. Should any marks be used on them, they must include the fineness mark at the very least. (Articles of precious metals in Finland 2012:8)

2.8.2 The responsibility mark

The responsibility mark indicates the importer, manufacturer or seller who is responsible for the article and its conformity with requirements. Articles of precious metals on sale in Finland must be marked with a responsibility mark duly registered with “Tukes”, or alternatively with a hallmark. Figure 12 presents the examples of responsibility marks.

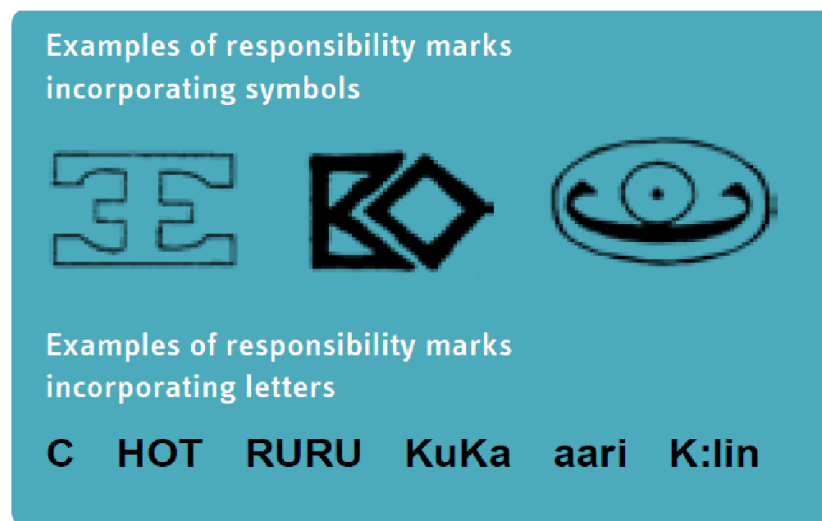


Figure 12. Examples of responsibility marks

2.8.3 The hallmark

The hallmark certifies that the product has been examined by an impartial assay office. A company or a private person not having a responsibility mark of their own may place the product on the market stamped with a hallmark and a fineness mark.

2.9 Manufacture and import of articles of precious metals

Any company or entrepreneur planning to manufacture or import articles of precious metals may file a written application with “Tukes” for a responsibility mark. The holder of the responsibility mark is responsible for ensuring that the articles marked in this way meet the requirements laid down by the Finnish legislation.

When importing articles of precious metals manufactured in other countries, a Finnish importer may order the articles to be stamped by the manufacturer with a responsibility mark registered in Finland and a fineness mark conforming to the Finnish legislation. The articles may also be ordered without marks. In this case, the importer must add the statutory marks before placing the products on the market in Finland, or he must have the articles hallmarked.

A manufacturer outside Finland may also apply for his responsibility mark to be registered with “Tukes” and added Tukes register, in which case the articles bear the manufacturer’s responsibility mark, and do not need the Finnish importer’s responsibility mark. It should be noted that the seller, manufacturer and importer are responsible for the product in Finland, even if it bears the responsibility mark of a manufacturer outside Finland. (Articles of precious metals in Finland 2012:15-16)

2.10 Internet trading

Anybody who sells articles of precious metals on the internet market must be responsible for their conformity in the same way as other entrepreneurs on the Finnish market. When it comes to internet trading, , it must be noted that both the Finnish Act and the Finnish Decree on Articles of Precious Metals also apply to the trade between private citizens. (Articles of precious metals in Finland 2012:17)

3 STUDY OF BACKGROUND INFORMATION

3.1 Mission/Vision of the company

The mission of the company is to offer its own consumer jewelry products, which would awake their feelings and memories, about some things they experienced, seen or would like to feel, by reflecting them in sensible signs of form and structure as a collective consciousness is reflecting in our interconnected world, where we all as population or segmented group of population take a credit for creation.

3.2 Company name “Shibumi”

Name of the company refers to the original meaning of the term. That fact gives some understanding of company’s main values, principles and mission in design point of view, as well as in other aspects of company’s business.

3.3 Design statements of the company

3.3.1 “Shibui”

“Shibui” is a Japanese term that describes simple, natural, subtle and unostentatious aesthetics. Originally that term referred to a binding, sour taste, such as taste of unripe persimmon. At XVII- XVIII centuries the term began to be used for describing tastes in music, fashion, craftsmanship, which referred to it as being beautiful in a direct and simple way, without being flashy. Shibui objects appear to be simple overall but they include intangible details, such as textures, or forms that balance simplicity with complexity. (Shibui 2008). Examples of Shibumi aesthetic objects are presented in Figure 13.

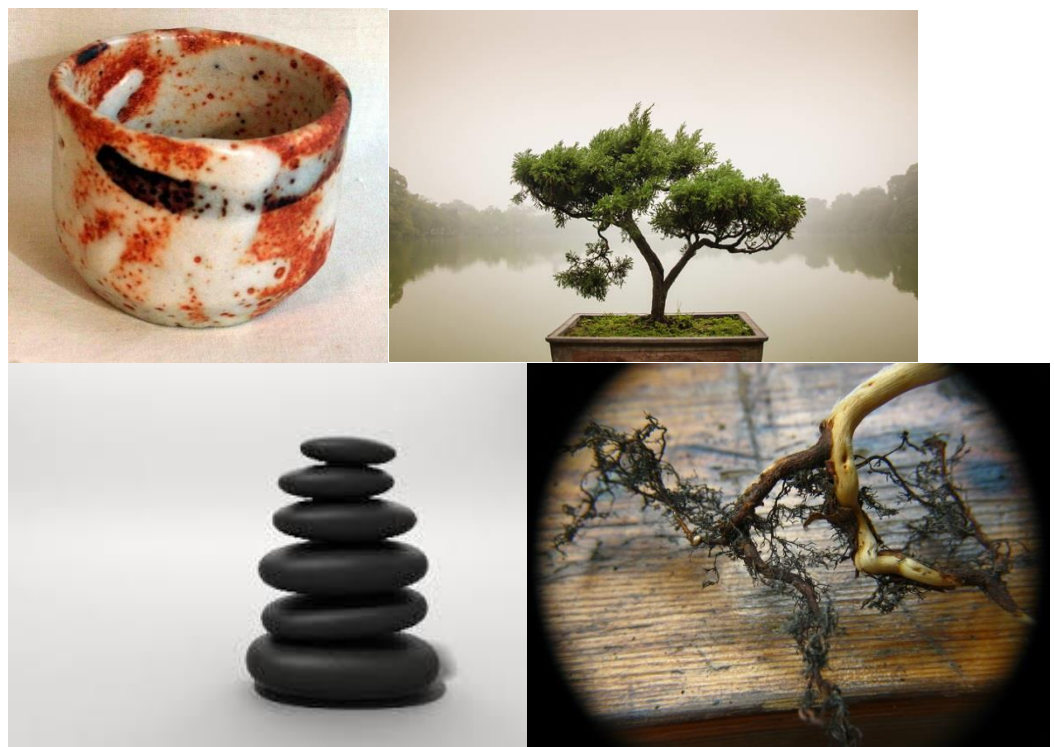


Figure 13. Examples of Shibumi aesthetic

This balance of simplicity and complexity ensures that user does not get tired of a shibui object but all the time finds some new meanings and enriched beauty that cause its aesthetic value to grow over the years. Shibui is a great balance between elegance and rough or spontaneous and reasonable. The “Unknown Craftsman” refers to shibui as “beauty with inner implications”. It is not a beauty displayed before the viewer by its creator; ; creation here means making a piece that will lead the viewer to draw beauty out of it for oneself. There are seven elements of shibui: simplicity, implicitly, modesty, silence, naturalness, everydayness, and imperfection. It is soothing and fulfilling, showiness is avoided. Muddy, silver-grey tones are mostly used in shibui aesthetics.

3.3.2 Deepness and simplification

Another important statement which affected, the design process, and the theme is "deepness and simplification". Those two are related each to another, so that one is explaining another. What makes something simple or complex; is not just amount of information, but also the way the information is arranged.

Depth is what is not visible immediately at the surface of things. Depth is what is below that surface: a body of water below the surface of a lake, the rich life of a soil below the dirt or the spectacular line of reasoning behind a simple statement.

Depth is a straightforward aspect of the physical world. Gravity stacks stuff and not everything can be at the top. Below there is more of it and you can dig for it.

Depth acquired a particular meaning with the rise of complexity science a quarter of a century ago: What is characteristic of something complex? Very orderly things like crystals are not complex. They are simple. Very messy things like a pile of litter are very difficult to describe: They hold a lot of information. Information is a measure of how difficult something is to describe. Disorder has a high information content and order has a low one. All the interesting stuff in life lies in-between: Living creatures, thoughts and conversations. Not a lot of information, but neither a little. So information content does not lead us to what is interesting or complex.

The marker is rather the information that is not there, but was somehow involved in creating the object of interest. The history of the object is more relevant than the object itself, if we want to pin-point what is interesting to us.

It is not the informational surface of the thing, but its informational depth that attracts our curiosity. It took a lot to bring it here, before our eyes. It is not what is there, but what used to be there, that matters. Depth is about that. (Brockman. J. 2012: 226-227)

Simplification in nature is water, soil, oil, air. These are simple things we all know, but the deepness behind them that what attracts our curiosity, these simple things are giving the life at first, making complex creations, which consists so huge amount of information, that we with all our technology could not still observe deep enough. Information is being simplified by natural processes, from very complex, to the simplest well-arranged substances, for them to become again the source for complex things.

Adding the layers of information, to the design process, and to the final look final look of the project, by treating models and materials, with the use of natural processes, author tries to minimize the narrowing of this information due to his own taste, but let's the nature express it's influence.

Lifecycle, legacy of the nature, timeless balance of it, or unexpected touch of life, some small detail like a waft of a wind, or a first snowflakes on a still living flower, etc. ,those are the things, that nothing but nature itself , with its physical processes, could reflect on the product, and support the inspirational meaning of the project.

4 DESIGN PROCESS

The most creative part of the project was a process of creating the master model for casting. This means a process of creating the forms and the surfaces, which will appear on the final product after casting.

4.1 Blending of design techniques with natural processes

In lost wax casting, the material used to build a model is a wax or compositions where wax is a main ingredient. Plasticity of the modeling wax, and the fact that it can be used in either solid or liquid state, while making models, makes it a perfect tool, with unlimited possibilities of form and surface finishing. The greatest attribute of this technique is that almost any form and detail, which can be made with wax, will have an accurate reproduction in metal, after the casting process.

In order to support discussed design statements, the traditional method, of carving or building the model out of wax, was studied, to find the possibilities of changing it in such a way, that it would be blended with natural processes like freezing or senescence of organics, as well as natural organic materials were used in combination with wax to build a master models.

4.2 Collecting of organic material

The organic material as leaves, flowers, branches of trees, different kinds of bark and moss was collected at first. Variety of them shown in Figure 14. The emphasis was on finding unusual solutions of nature, such as interesting joint, or a shape, sometimes it is some special moment for a piece, such as just opened seed, or still full of life, but half dried flower. Another criteria, was to find beautiful surfaces, which transferred on metal, would attract not only by the look of it, but by the tangible relief also. It is critically important to be able to visualize even on that stage of the process already, how your ideas would appear, when cast with metal.



Figure 14. Organic material.

4.3 Strengthening of fragile pieces

Some very fragile pieces, that required strengthening, and the ones which shape needed to be fixated, were painted with a thin layer of molten wax. In some cases where it was difficult to reach the surface, or for the outer surfaces, which shouldn't be covered with wax layer, in order to transfer its original pattern to the metal, author used clear transparent lacquer spray for strengthening.

4.4 Two different approaches used to build models

At this point, the design process was split, on two different ways, of archiving result. One was meant to use traditional ways, of working with wax, and building a shape of model out of it. However applying natural processed at the finishing stage, and for producing tangible surfaces. Another technique was made to get the shape and a finishing with the use of nature. The result can be seen in Figure 15.



Figure15. Model built out of organic material.

4.5 Traditional Wax carving method

4.5.1 From raw sketches to technical drawing

One way was more traditional, and it started with the raw sketches, on this stage drawing is more intuitive than, planned, it is just a search for a shape or surface, style or material. These drawings were not meant to be a particular plan, and a visual copy of the final product. An example of sketches are shown in Figure 16 However they are playing important role for a project, and author, by being an inspirational source, and some kind of a style guide for the pieces, that actually would be designed and produced.



Figure 16. Example of raw sketches.

The drawings were analyzed, and the ones, that follow the given concepts, and meet the requirement, that the “Lost wax casting” technique set, were chosen.

After that the technical drawings were made. To have a clear plan, author used two views, a top plan and a side view. Detailed plan, is a great help, when it comes to the wax carving, it makes the work flow, without disturbance of deciding details, like thickness or proportions of details to each other.

4.5.2 Choice of wax

Wax comes in a variety of shapes, colors and brands. The wax I mainly use comes in three consistencies: soft, medium and hard. Each project will demand a choice be made from one of these consistencies of wax. In this project author was using different kinds of wax, for a different goals, even simple candle paraffin for attaching details. Types of wax used are shown in Figure 17.



Figure 17. Used types of wax.

4.5.3 Carving the wax

When the piece of wax, which matches the requirements, is chosen, it is time to mark the dimensions, on it. That should be done exactly, but shrinkage from the wax when cast into metal should also be considered.

After that, all the excess wax from around the marked shape was removed, with the use of jeweler's saw, for larger segments, or cut with scalpel in more detailed areas. At this stage it is more like shaping, not actually carving the piece. When the general shaping is done, it is time for more precise carving.

There are a huge variety of tools and materials, for wax-manipulation. Heat is one of the main tools, due to the physical properties of wax. Different kinds of metal spatulas, wooden spatulas, knives, scalpels, files and drills could be used cold or hot for different needs. See figure18.

With the use of some listed tools, planed shape was carved and finished in those areas, which are not meant to be manipulated anymore. On other parts where author planned to use organics, to transfer it's pattern, it was done with the use of electric wax welder.



Figure 18. Carving tools

4.6 Unique natural way of making the wax models

The second way was to let the nature play the role on the first stage already. That was made with the use, of different natural processes, like freezing the water, the wind power. Water, which was used here and on other stages of designing the master models, was brought from the same place, where the organic material was collected. In order to support the story behind the product, and the inspiration sources for the collection, one of which it the “Memory of water”, it was then structured with very special rock called “Shungite”, which can be found only in Karelia, very close to Kalevala – one of the main inspirational sources, and the region where organic material was collected, also water was charged with the vibes of traditional instruments and natural sounds, of karelian forest.

The organic material was placed into the bowl, and water was poured onto it as shown in Figure 19. The bowl was placed then under the minus temperature outside, to let the freezing process organize compositions, without any artificial disturbance.



Figure 19. Organic material placed in the bowl with water and structuring stones.

It was important not to let the water freeze completely, to avoid the difficulties in separating the pieces, but the layer of ice on surface, had to be hard enough, to hold the pieces.

The most interesting looking spots and formed compositions were then covered with the thin layer of melted wax as Figure 20 shows. On this stage a problem was in finding the right temperature of wax – to hot it was melting the beautiful ice surface, without getting it's pattern, if to cold, it couldn't follow the shape of organic pieces.



Figure 20. Wax poured on frozen organics.

The results gotten from this process, played about the same role, as raw sketches, they weren't giving the answer how the final product would look, but some of nice shapes and patterns were taken to further production. Each of these pieces were analyzed separately, to find the best way of adopting them to become a part of jewelry piece, and to get the good cast results.

The precise plan was drawn again, in the same manner as technical drawings, used before. According to that plan the pieces were built and carved, to become master models for casting. Example of master model and ready casted piece are shown on figure 21.



Figure 21. Example of wax/organic model, and the created piece.

5 THE PRODUCTION PROCESS

5.1 The choice of materials

5.1.1 Factors affected the choice of material

The factors affected the choice of the material for the final product:

- Low price of raw material, compared to another precious metals
- Appearance of silver supports “Shibumi” principles
- Material of not such a huge value, that would make people worried to buy it online.
- Material that, would bring a great contrast if used with the “Chemical dip coloring” process

5.1.2 Silver

Silver was used in jewelry production nearly as long as gold, mentioning of silver could be found in Greek mythology, as well as in Christian bible's books. Clearly the creation and use of silver in jewelry has an ancient tradition. Pure silver is very soft and easily damaged, so it's commonly mixed with other metals to improve durability for use in jewelry. Silver is normally mixed with Copper and there are several levels of purity that indicate the quantity of pure Silver contained in the metal. That is studied more detailed in the second chapter of this work.

As one of the precious metals, Silver is among the most popular metals for the creation of jewelry. While there are many possible reasons for this preference, most people cite the following reasons:

- Silver is Lustrous and Outshines Gold
- Silver is More Adaptable to Casual and Formal Wear
- Silver Flatters All Skin Tones
- Silver is Affordable

5.2 The choice of production methods

5.3 Casting process

5.3.1 Preparing the master model

Ready master model is prepared for casting by adding a wax channels to connect it with the pouring gate and the wax button. Through those channels the melted metal is filling the space left by molten model. The difficult shape of models, and the risk involved, because of the use of organic material which is difficult to know in advance, made it wise to use shorter channels, and bigger amount of them, they should lead to heaviest parts, where the greatest amount of metal must flow, but also, to most difficult small details separately as Figure 22 shows. The placement for the channels should be carefully analyzed, for each particular piece, so that it allows the metal flow rapidly into the mold, and fill all the sections of mold cavity.

Importance of this stage was proven after the first casting test, where some parts of the mold cavity were not filled with the metal.



Figure 22. Example of prepared wax-tree for casting.

5.3.2 Estimating amount of metal needed for casting

The next step was to estimate the amount of metal needed for a casting. The wax tree with all channels and models attached should be weighted. Then it's multiplied by the silver to wax weight factor which is 10.5. The use of organic material, which is replacing wax, again brought some specifications to these calculations, because the weight of natural leaves, branches and other surfaces used, is different to the weight of wax. Calculation of weight factor of organic material to wax was made:

5.3.3 Preparing the flask

When all calculations were made, the wax tree was placed on a rubber base of a flask that would hold the investment plaster. The casting was made with the use of vacuum assist casting table, which uses the flasks with the walls perforated with the number of holes to allow the air to be drawn out. That kind of flask should be wound around with the tape, as Figure 23 shows, to preserve the leaks while pouring the investment. Also knowing that vacuum table would be used for air

removal, and to prevent the investment overflow while bubbling process , some tape was wrapped above the upper edge of the flask, making about 25millimeters high “safety band”.



Figure 23. Preparing the flask.

5.3.4 Preparing the investment

This process requires the knowledge of the investment setting time, which is a period of 10 minutes, where 3-4 minutes are spent on mixing investment, using hand as shown on Figure 24; 2-3 minutes to get rid of the bubbles using vacuum table; half of the minute to pour the investment into the flask; 2 minutes for the flask in the vacuum table and 2 minutes for the plaster to set.

To get the best casting result, and get the required quality of surface, the mixing ratio of water to powder, was chosen to get more delicate investment, but so that it would not affect the physical properties and cause any weakening of plaster.



Figure 24. Mixing the investment.

After the investment was mixed it was placed under a plastic jar on a vacuum table, in order to get all the air bubbles out of it. The next step was to fill the flask with the investment. It can be done by simply pouring it into the flask to a level that covers the models but not quite reaching the top of the flask, and lightly taping it with the metal tool to the upper edge, but the most efficient way of doing that, is to place the flask onto the vacuum table, but for just a minute.

Investment needs to rest time after hardening to achieve full strength. This allows the investment to be hard enough to take the expansion of the pattern material when the heating starts. Small flasks need at least an hour and larger flask should be held for a minimum of two hours to get good strength.

When the investment is set, the rubber base should be removed, and the outside surface of the flask should be cleaned of any investment that leaked on it. The top surface is cut with any sharp edge metal stick, to match the top edge of the flask, and any needed marks, like the number of the flask or material to be poured in it, are scratched on it.

5.3.5 The burnout process

After the plaster was set, and dried for 2 hours, tape and a rubber base was removed from the flask, which is to be set into the special kiln, for burnout process, as Figure 25 shows.

There are 4 heating stages in burnout process:

- The first stage in the actual burnout is the low temperature removal of the bulk of the pattern material. This is most commonly done at 93-148 C for one and a half to three hours depending on how large the flask and how much pattern material you have to move out.
- The second stage is to get your mold up to the high temperature 600 C needed to remove the carbon. There are a few things going on during this cycle that require attention. In this ramp up you finish removing the water from the mold, and you pass through some thermal expansion zones where your investment expands. 7-9 C a minute is a good average speed to avoid steam and thermal shock.
- The third stage the temperature is quickly raised to its maximum of about 730 C The duration at this temperature ranges between three and five hours, dependent on size of flask and airflow.
- The fourth stage is when the burnout is complete, but the temperature should drop, to a temperature proper for casting silver. It will take a mold one to two hours, dependent on flask size, to stabilize at a lower temperature of about 400-480 C

(Untracht.O. and Hale.R. 1985: 519-520)

For the sake of being sure, of getting good burnout of other material than wax, the maximum temperature was increased. Similarly casting temperature could be set a bit higher.



Figure 25. Flasks in the kiln

In order to get away the possible ash dust, which could be left in the flask, during the burnout process, of non-wax material, supervisor proposed to use the vacuum cleaner, applied to the only possible escape gate of the flask as Figure 26 demonstrates, after its temperature is stabilized on the casting level. After cleaning the flask was placed back into the kiln, to wait for the casting.



Figure 26. Applying vacuum cleaner, to get read of the ashes

5.3.6 Preparing the metal

The estimated amount of metal is placed in the crucible. The best raw material is a grain form pieces of very clean silver, but the cast pieces and other silver scrap could be used also, though not more than for a half of a needed weight. See Figure 27.



Figure 27. Preparing silver for casting

Heating of the metal as Figure 28 shows, is made with the use of the torch, when the right part of the flame touches the metal, it appears shining and bright; the flame should cover the metal during all process of melting up to a time when metal is poured into the mold. The flame should fill the crucible, in a spiral direction and should not bounce back into the torch. When the metal becomes hot, some of casting flux should be added, and another time, when the metal appear to have a rounded form. Flux is preventing the oxidation of the metal, by coating the surface of it.

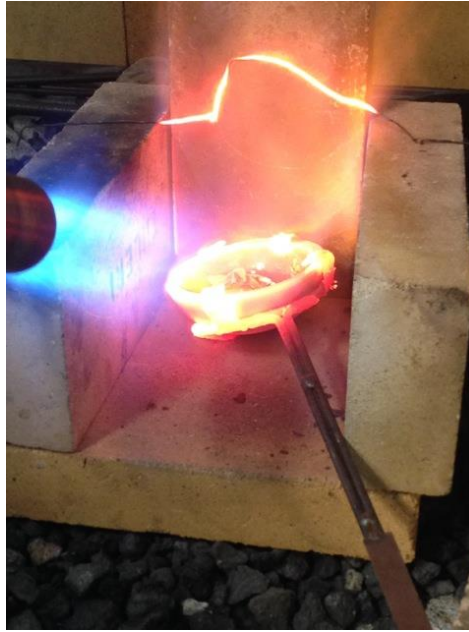


Figure 28. Heating the metal with the use of the torch

When the metal is close to reach the temperature about 40-65 C above its liquid temperature, the flask with the metal was in the kiln on about 400-480 C - perfect casting temperature, could be placed on the vacuum assist casting table. For this process two persons were needed, so that one prepares the melt metal, and another removed the flask out of the kiln and placed it on a vacuum table. When the table's motor was started, and the pump valve was closed, the melted metal is evenly and quickly poured into the flask as shown on Figure 29.

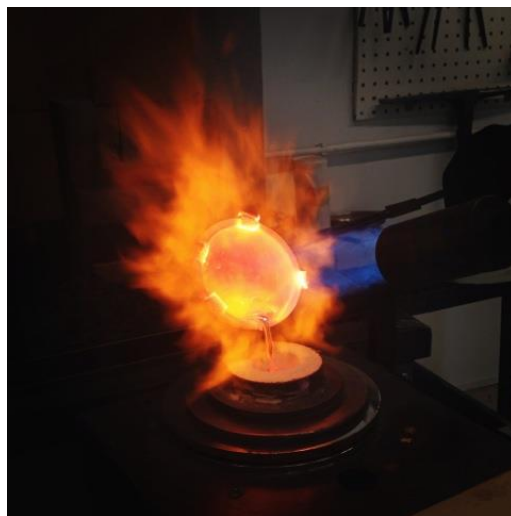


Figure 29. Pouring molten metal

When the flask cool down a little bit, so that the visible surface of metal, shown on Figure 30, becomes dark, it could be removed from the table and deepen into the tank of room temperature water, as Figure 31 demonstrates. Removing the channels, and pieces is made with the use of jeweler's saw, or by cutting them of with the special nippers.



Figure 30. Flask with just poured hot metal.



Figure 31. Flask placed in the water.

5.3.7 Polishing process

In order to meet the existing standards in appearance of silver jewelry, one of the necessary processing steps is polishing. It is usually made manually with the use of different types of polishing wheels, as well as with the use of electrochemical treatment. Figure 32 demonstrates the polishing tools, used for the project. Ideally jewelry should be completely smooth and free of defects and scratches, it should reflect the light evenly, and shine should be bright. For particular pieces, which were produced for this project, the critical meaning was in the intensity and a choice of tools, which were used for polishing different parts of them. Some parts we made to retain the original mandrel of organic material and all its fine detail, they should be polished carefully, only with the finest abrasives. Insights of the rings, and some of the outer parts of them, had to go through all stages of polishing, starting with the raw abrasives, and changing them until the finest one, and at last by gently hitting the surface with the stainless still ball, to get the perfect surface and a brightness on it. The basic soap was used then to remove stains of polishing compounds, by gently brushing and rinsing through running water, or for some difficult accessible parts, the use of ultrasonic cleaner was needed.



Figure 32. Polishing tools.

5.3.8 Coloring technique

In order to reach higher contrast level on uneven surfaces, the chemical dip coloring was made. Chemical deep coloring is one of the most popular techniques for coloring metal; the result is a thin layer of a compound on a base metal; the deepness of a color, depends on the length of the period when the reaction is applied. Coloring can be made by simply dipping the piece into solution, or by applying it locally with a brush. Figure 33 shows the difference of appearance of the same piece before and after coloring. After that with the use of abrasives and different polishing tools, upper layer of metal is brought back to the desired degree of brightness, to create the highlights on the object. Figure 34 shows the finished ring.



Figure 33. Shows the same piece before and after chemical deep coloring



Figure 34. Ready to wear silver ring

6 CONCLUSION

During the project the research of jewelry production methods was made, in order to find unusual ways of interpretation the company's design statements and vision. Developing the process of making models for casting, with the use of natural processes and materials, gave good results. The aesthetics of ready pieces, reflects the principles of Shibumi, and becomes a visual guidance to Shibumi's company style. Result as ready to wear line of silver rings, is a great base for the company to build its product range, where some of the pieces would be one of a kind, and some would be reproduced in limited editions.

The conjuncture of modern jewelry market shows that even it is so saturated, there is still growing interest in original artistic jewelry. Methods used for design and production along the project, shows the ability to apply the layers of information on all stages, in order to get at the end jewel, that user does not get tired with, but all the time would find some new meaning and aesthetic value in it. The marker is rather the information that is not there, but was somehow involved in creating the object, the history of the product is even more relevant than the object itself, because it is not informational surface, but it is informational depth that attracts our curiosity.

REFERENCES

BOOKS

Articles of precious metals in Finland. Safety Technology Authority 2005

Brockman. J. 2012. This will make you smarter. London: Transworld Publishers Limited

Forkadel Berenger. M. J. 2003. Dibujo para joyeros, Drawing for jewelers. Barcelona

Nakayama.M. and Stucky.J. 2008. Japanese Culture Notes. Mineharu Nakayama and Janet Stucky. . Institute for Japanese Studies, The Ohio State University, and Global Horizons.

Untracht.O. and Hale.R. 1985. Jewelry concepts and technology. London

Zi Ye and Tao Jiang.2013. Importing Neoglory Jewelry to Finland.
KYMENLAAKSON AMMATTIKORKEAKOULU

INTERNET

All about silver www.jewellerymaker.wordpress.com Posted 04.2008[Accesed 14 April 2014]

. www.modern-bijouterie.blogspot.fi Posted 03.2011[Accessed 24 January 2014]

Recycling Gold, Silver & Other Precious Metals www.greenxchange.cc Posted 11.2012[Accessed 14 April 2014]

Shibui. www.woodka.com Posted 02.2007 [Accessed 6 February 2014]

Vella Lisa. 2014.Why Buy Hand Crafted Jewelry? <http://www.swcreations.net> [Accesed 20 February 2014]

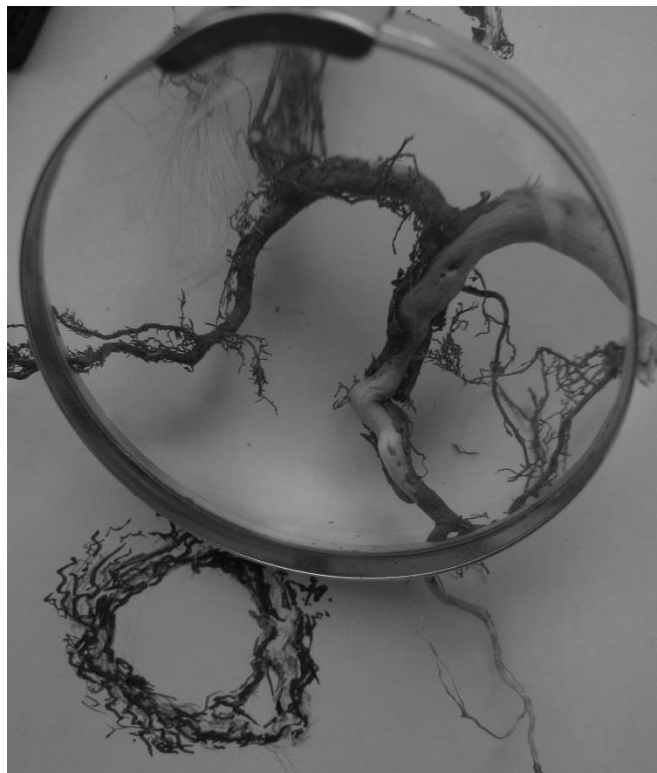
OTHER

New Oxford American Dictionary

APPENDICES



Picture 1. Tree branch, used as a base, for a model of the ring.



Picture 2. Sketch of the ring.



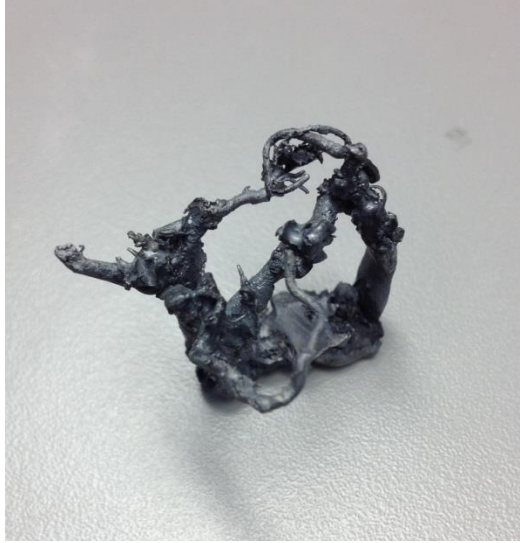
Picture 3. Detailed sketch of the ring.



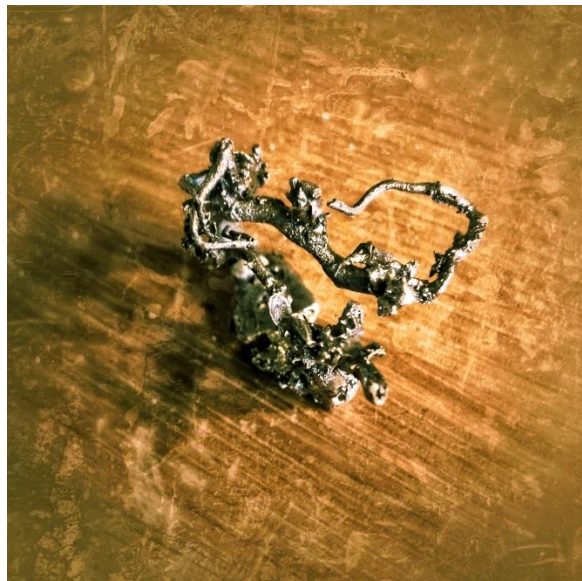
Picture 4. Master model for casting.



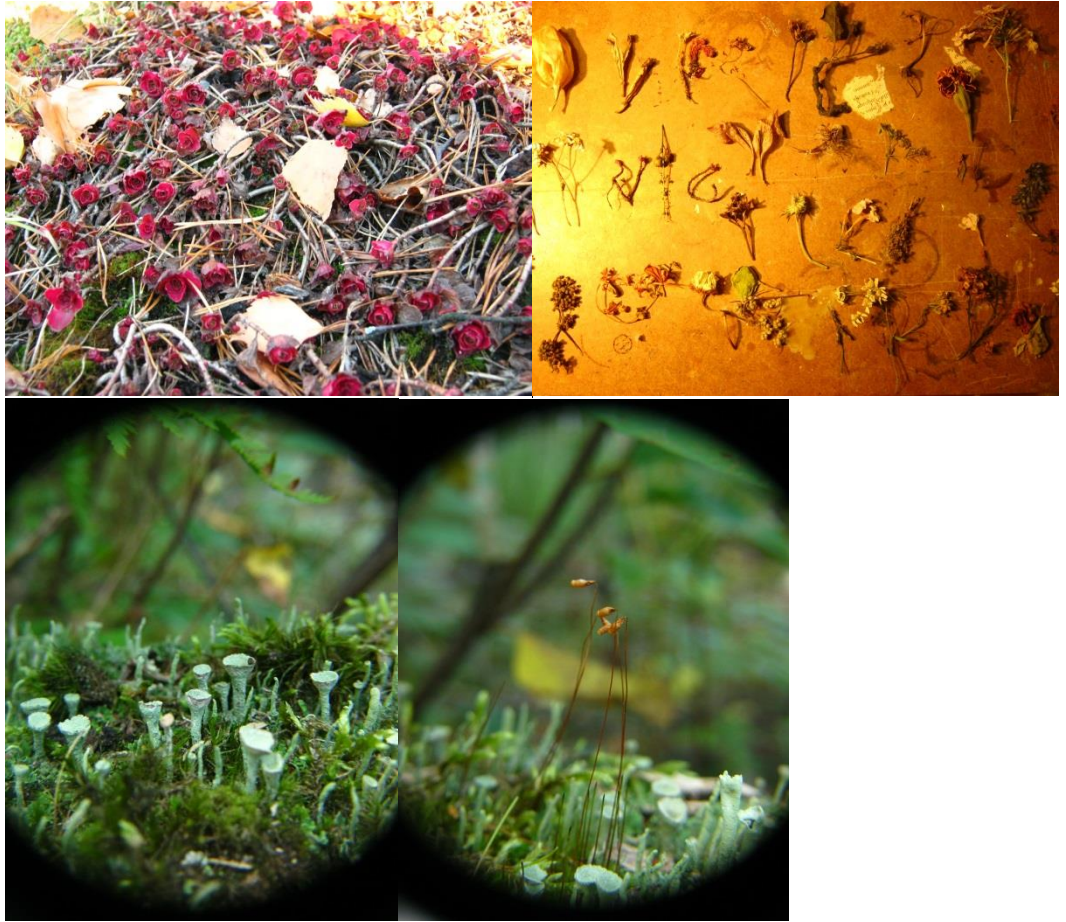
Picture 5. Silver model after casting.



Picture 6. Model after chemical deep coloring



Pictures 7, 8. Ready to wear silver rings

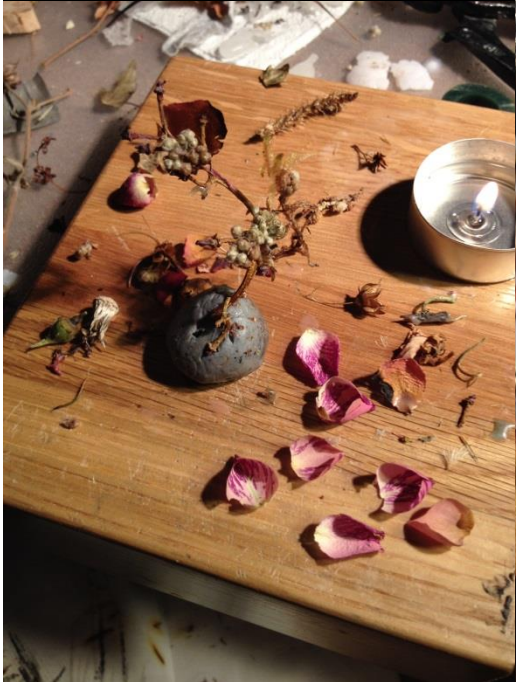


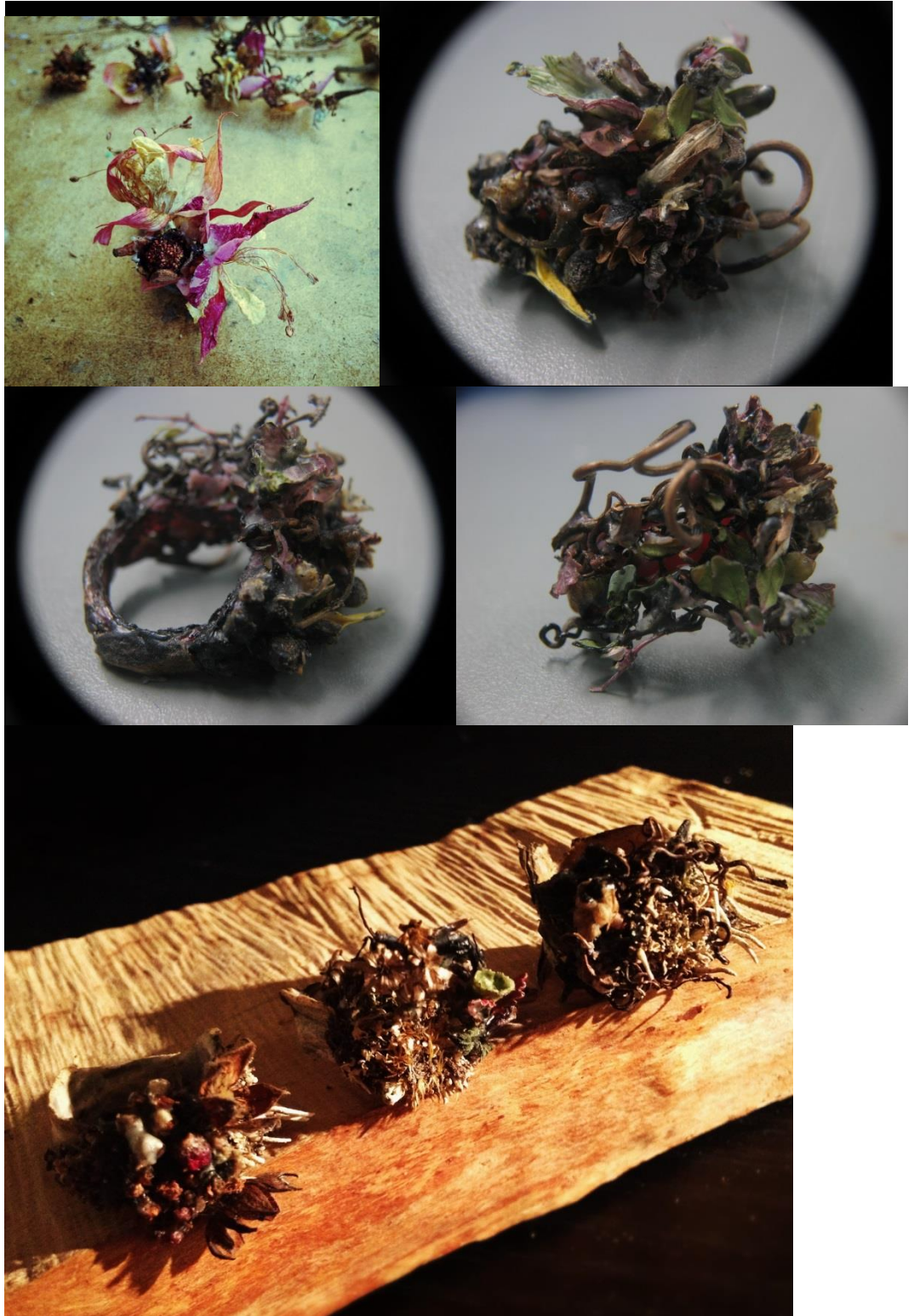
Pictures 9, 10, 11, 12. Examples of collected organic materials.



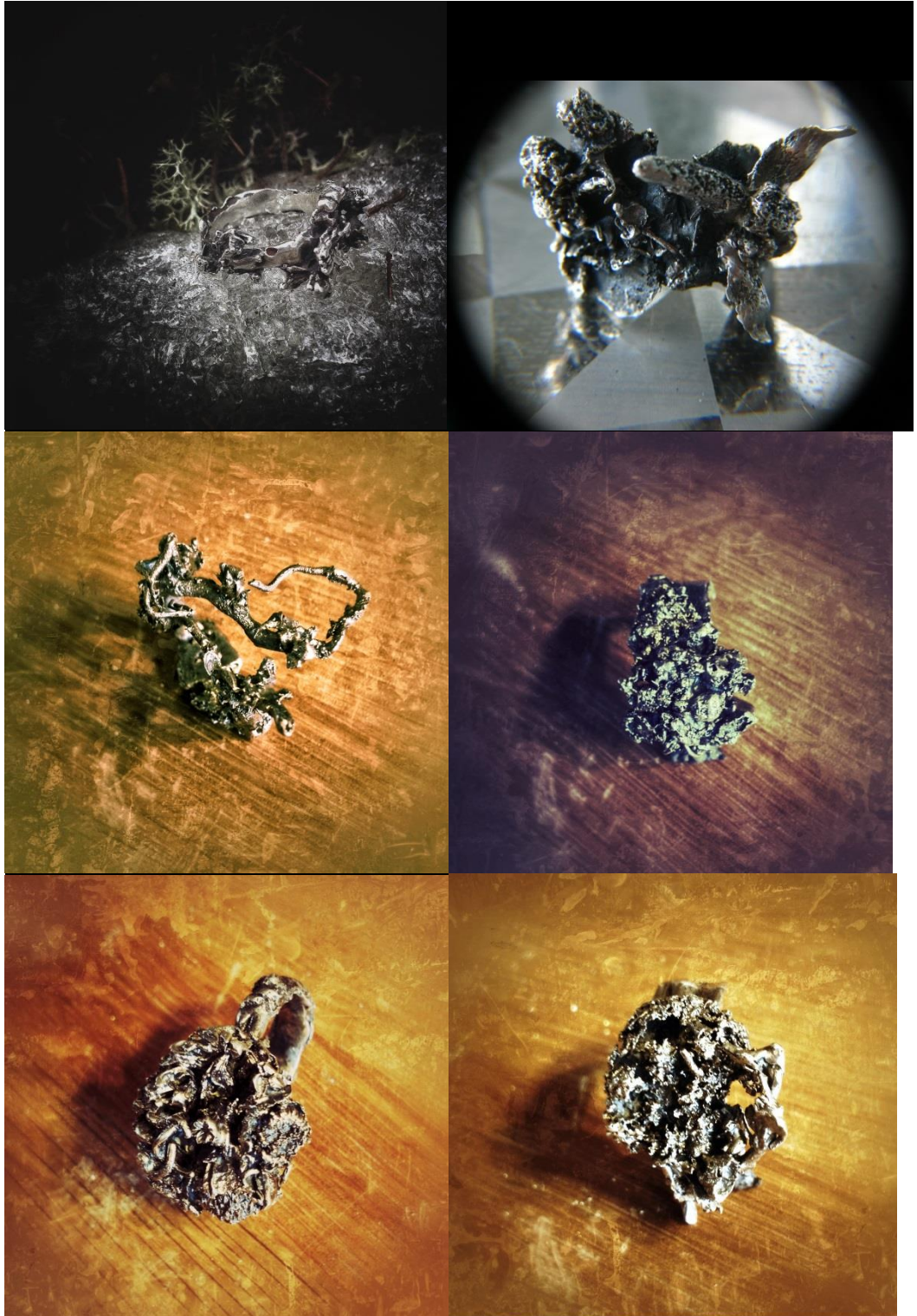


Pictures 13, 14, 15, 16, 17. Sketches made during the project.





Pictures 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28. Process of building master models for casting.



Pictures 29, 30, 31, 32, 33, 34. Ready models of silver rings.